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Are legacy airline mergers pro- or anti-competitive? Evidence from recent U.S. airline mergers☆

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A B S T R A C T

Due to a series of recent mergers, the number of legacy airlines in the United States has decreased from six to three. We conduct a comprehensive investigation of the effect on fares and output of these legacy airline mergers to determine whether the mergers have had an overall pro-competitive or anti-competitive effect on consumers. Our difference-in-differences regression analysis shows that these mergers have been pro-competitive, with no significant adverse effect on nominal fares and with significant increases in passenger traffic as well as

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capacity. Taken together, the results indicate that the recent legacy mergers were pro-competitive.

1. Introduction

Since deregulation in 1978, the U.S. airline industry has experienced waves of entry, mergers and bankruptcies that have caused the industry to become more concentrated than it once was. This pattern of industry consolidation has continued into the 21st century; in the past ten years, six legacy carriers have merged into three: Delta Airlines and Northwest Airways merged to form Delta Airlines; United Airlines and Continental Airlines merged to form United Airlines; and American Airlines and US Airways merged to form American Airlines.

There is an on-going debate whether these recent mergers have had a pro-competitive or anti-competitive effect on consumers. The argument for anti-competitive effects is that the mergers have reduced competition and thereby led to higher airline fares and lower output. The argument for pro-competitive effects is that the mergers have enabled the airlines to take advantage of network effects, with the improved network of service (e.g., more online connections to more airports, better frequent flyer programs) improving product quality, and thereby attracting more passengers leading to greater output.

In this paper, we investigate which of the two effects have prevailed. We are able to differentiate between the two effects because they have very different empirical implications: The anti-competitive explanation predicts that airline mergers lead to higher fares and lower output, particularly on routes where the two merging carriers—and few other carriers—provided service before the merger.[1] On the other hand, the pro-competitive explanation predicts that as a result of efficiencies airline mergers lead to lower fares and increased output, particularly on overlap routes since they are generally at the heart of the combined network. In studying these two effects, the effect of the merger on output is critical because it captures the all-in competitive effects reflecting, among other factors, the airlines' quality of service and the airlines' non-fare revenues such as baggage fees and early boarding fees.[2]

[1] We focus on overlap routes (using non-overlaps as controls) because that is where anticompetitive effects have been considered most likely, both in the economic literature and in the DOJ investigations of merger activity. We consider mechanisms of harm to competition that do not have the largest effect on overlap rules to be unlikely, but to the extent they exist, our paper does not address them.

[2] Given the importance of quality competition, it is important to recall that a merger's effect on *nominal fares* is an incomplete measure of the merger's full competitive effects, even if one could adequately account for ancillary fees. In particular, if one sees average nominal fare increases following a merger, but also sees output increases, then such fare increases are not necessarily indicative of anti-competitive effects. Rather, this combination of nominal fare increases and output increases could point to higher quality and thus greater demand for air travel (that is, a reduction in quality-adjusted fares). Alternatively, the combination could point to a changing mix of passengers, with the output increase disproportionately occurring among

We focus on legacy airline mergers because they operate the hub and spoke networks that are more likely to get the network effects from mergers. The effect of mergers of "low cost carriers" likely differ in multiple dimensions and are worthy of separate analysis on their own terms.

In our empirical analysis, we employ a difference-in-differences approach, which allows us to compare how the variables of interest changed between pre- and post-merger periods on routes where mergers were expected to have the strongest competitive effects (i.e., overlap routes) relative to other routes. This methodology has been used in previous legacy carrier merger investigations (see, e.g., Heyer et al., (2009)).

Our main conclusion is simple: The recent legacy carrier mergers have been associated with *pro-competitive* outcomes. We find that, on average across all three mergers combined, nonstop overlap routes (on which both merging parties were present pre-merger) experienced statistically significant output increases and statistically insignificant nominal fare decreases relative to non-overlap routes. This pattern also holds when we study each of the three mergers individually. We find that nonstop overlap routes experienced statistically significant output and capacity increases following all three legacy airline mergers, with statistically significant nominal fare *decreases* following Delta/Northwest and American/US Airways mergers, and statistically insignificant nominal fare decreases following the United/Continental merger.

For connecting overlaps, while none of the estimated coefficients are statistically significant, the results are suggestive of small decreases in quality-adjusted fares, as the point estimates show increases in output.

The paper proceeds as follows. In Section II, we discuss the related literature. In Section III we provide industry background. In Sections IV and V we describe our estimation methodology and data, and present the estimation results. In Section VI, we conclude.

2. Related literature

Our paper contributes to an extensive literature on merger retrospectives, which evaluates the competitive effects of mergers and the accuracy of the government enforcement process (see e.g., Carlton, 2009 and Kwoka, 2013). Not surprisingly, studies find varying effects from mergers in different industries (see, e.g., Ashenfelter and Hosken, 2010, Ashenfelter et al., 2011, Kwoka, 2013, 2015, and Pires and Trindade, 2015).

In the airline industry, the studies of earlier airline mergers generally found that airlines mergers led to loss of competition and increase in fares (see, e.g., Werden et al., 1991, Borenstein, 1990, Peters, 2006).[3] It is important to emphasize that the mergers analyzed in these studies all took place more than twenty years ago, in 1980s and early 1990s.

business passengers who tend to place a high value on air travel and thus purchase relatively more expensive tickets.

[3] Our brief literature review focuses on the effect of airline mergers on carrier fares on the affected routes where both merging carriers are present before the merger. We note that Kwoka and Shumilkina (2010) study the fare effects of eliminating potential competition and find that one earlier merger, USAir/Piedmont, also led to an increase in fares on routes where one carrier was present but the other was a potential entrant.

In contrast, and despite what seems to be a common complaint in press accounts and even in government statements about the adverse effect of the recent legacy mergers on fares,[4] studies of more recent mergers are generally inconclusive as to the overall effect of specific mergers. The most intensively studied recent merger is Delta/Northwest and studies of that merger generally do not find large effects. For instance, Mehta and Miller (2012), Jain (2015) and Hüschelrath and Müller (2015) find that the transaction led to small fare increases, between 1 and 4%, on the affected routes, while Luo (2014) concludes that the fares on the affected nonstop routes did not change, and fares on the affected connecting routes increased by about 2%. At the same time, Mahoney (2014) argues that the cumulative effect on fares, which combines market-level and firm-level effects, is negative, meaning that the overall effect of the merger was a reduction in fares.

None of these recent studies investigate the effect of the merger on the number of passengers on the affected routes, and thus they cannot address the bottom-line competitive effect of the merger including any effects on quality or non-price fare changes (such as effects on ancillary fees). Our study focuses on output effects and thus fills this gap in the literature (as well as combining study of the Delta/Northwest merger with study of the two more recent legacy airline mergers).

The evidence in the economic literature with respect to the United/Continental merger is more limited, but generally does not suggest that its longer term effect will be significantly anti-competitive (see, e.g., Jain, 2015 who finds that the merger reduced fares by 3–4%).[5]

To the best of our knowledge, our study is the first study that examines the effects of the American/US Airways merger and the first study that provides comprehensive analysis of the output and fare effects of the three recent legacy mergers in totality.

3. Industry background

Following deregulation in the late 1970s, the airline industry experienced two waves of airline entry: immediately after the deregulation (between 1978 and 1984), and again in the first half of 1990s. These two periods of explosive growth in the number of carriers has subsequently been counterbalanced by exits and consolidation. (See Borenstein and Rose, 2014 for a detailed exposition on the history of the industry.)

By 2005, the number of legacy carriers had shrunk from more than twenty at the time of deregulation to six. These six legacy carriers were American, Continental, Delta, Northwest, United and US Airways. All of these carriers have filed Chapter 11 bankruptcy

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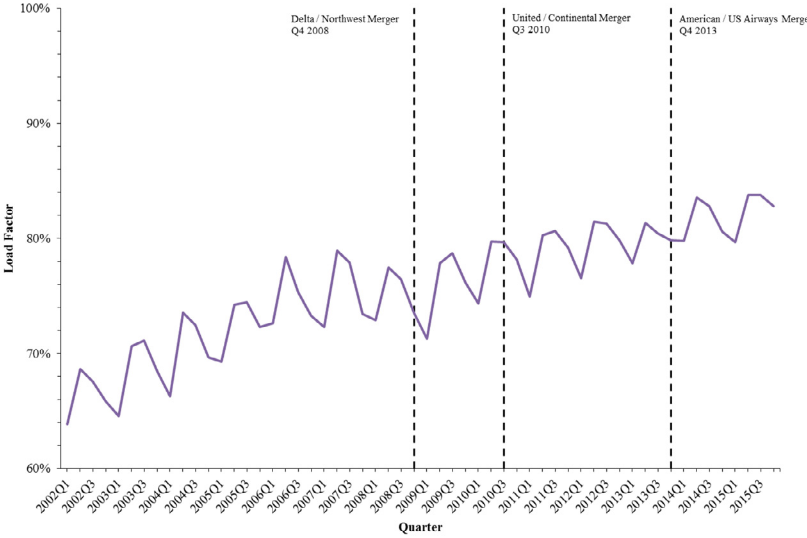
[4] See, e.g., "The American Way," by Justin Elliott, ProPublica, October 11, 2016, https://www.propublica.org/article/airline-consolidation-democratic-lobbying-antitrust, or "America's Monopoly Problem: What Should the Next President Do About It?," by Senator Elizabeth Warren, a lunch keynote address at the New America's Open Markets Program Conference, June 29, 2016, https://www.newamerica.org/open-markets/events/americas-monopoly-problem/.

[5] In a related study, Prince and Simon (2015) investigate the effect of recent airline mergers, including the Delta/Northwest and United/Continental mergers, on airlines' on-time performance and find that it worsens in the short run, but it improves in the long run because of the efficiency gains.



Source: DOT BTS T-100.
Notes: Load factors defined as a ratio of total number of passengers to total number of seats.

Fig. 1. Load factors.

at least once; most recently American Airlines filed for bankruptcy in 2011. As mentioned above, these six legacy carriers have since 2005 consolidated into three remaining legacy carriers: American Airlines, Delta Airlines, and United Airlines.[6]

Before turning to the rigorous econometric analysis in the next section, we begin with an overview of industry-wide trends around the time of each merger. These trends show patterns that are not consistent with widespread harms from the mergers, a finding that is bolstered by the results of our econometric analysis in the next section.

We start with the analysis of industry-wide load factors, which are shown on Fig. 1. This figure provides a first indication that the mergers may not have had an anti-competitive effect: As shown in Fig. 1, the steady upward trend in industry-wide load factors that started in early 2000s has not been affected by the mergers. If the mergers had anti-competitive effects, one might expect that, at least in the short run, the associated fall in output would lead to a decline in load factors, which is not observed in the data.[7]

While the airline industry has been largely unprofitable for most of the post-deregulation era (see Borenstein, 2011), Fig. 2 illustrates that the airlines' financial performance has improved in the last few years. Note that both pro-competitive and

[6] The Delta/Northwest merger was announced on April 14, 2008 and approved by the government on October 29, 2008. The United/Continental merger was announced on May 3, 2010 and approved on August 27, 2010. The American/US Airways merger was announced on February 14, 2013 and approved on November 12, 2013. While the Delta/Northwest merger was approved unconditionally, government approval of United/Continental and American/US Airways mergers was conditioned on sale of certain merging parties' assets, such as takeoff/landing slots and gates, to other carriers.

[7] As is evident from the figure, the immediate declines in load factors that occurred after each legacy merger are consistent with the common seasonal pattern. This "sawtooth" pattern (also apparent in the enplanements series in Fig. 4) is due to seasonal increases in travel during summer months.

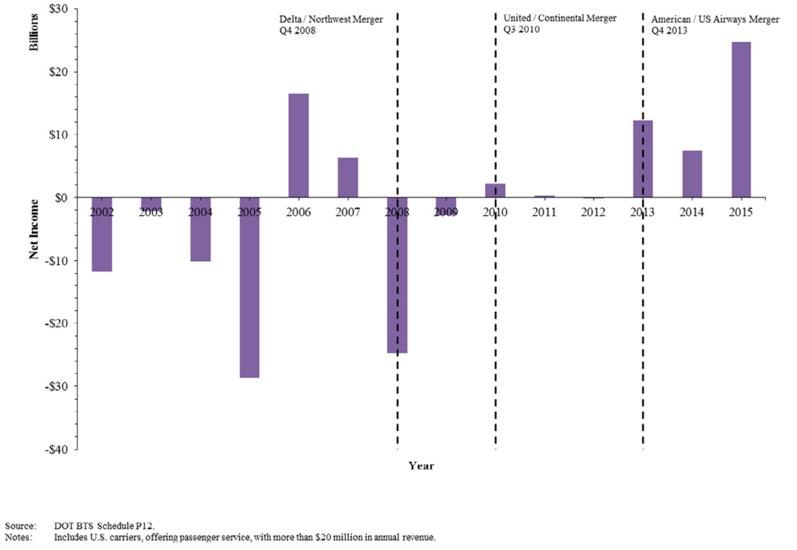


Fig. 2. U.S. passenger airline industry profitability.

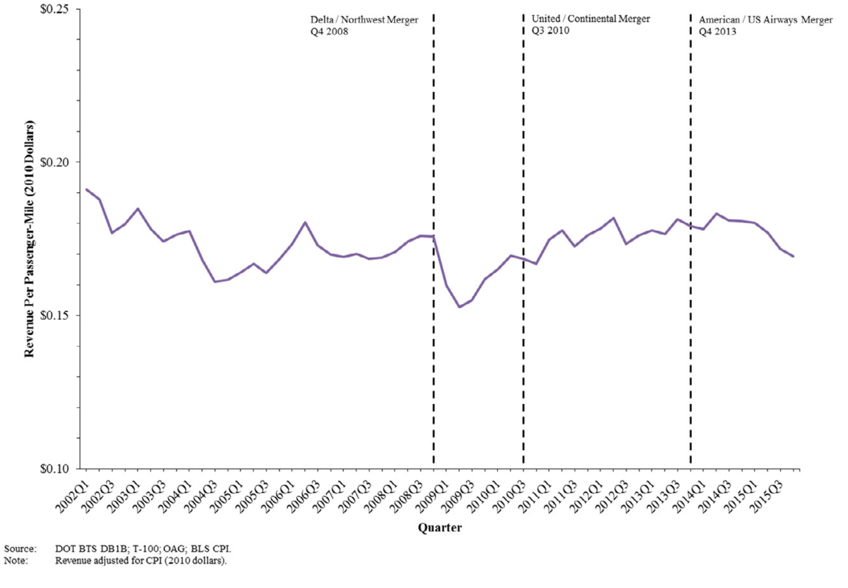
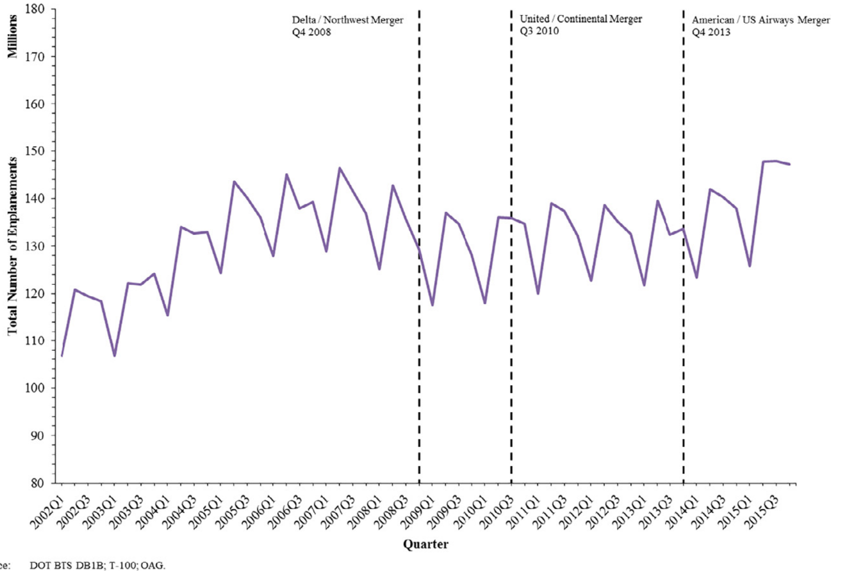


Fig. 3. Real revenue per passenger-mile.

anti-competitive merger effects can lead to the improved carrier financial performance (albeit via different channels); therefore, improvements in carrier profits do not allow one to disentangle the explanations.

Fig. 3 shows trends in real yields, measured as inflation adjusted revenue per passenger-mile. Real yields, a proxy for airline fares, have been fluctuating between $0.16 and $0.18



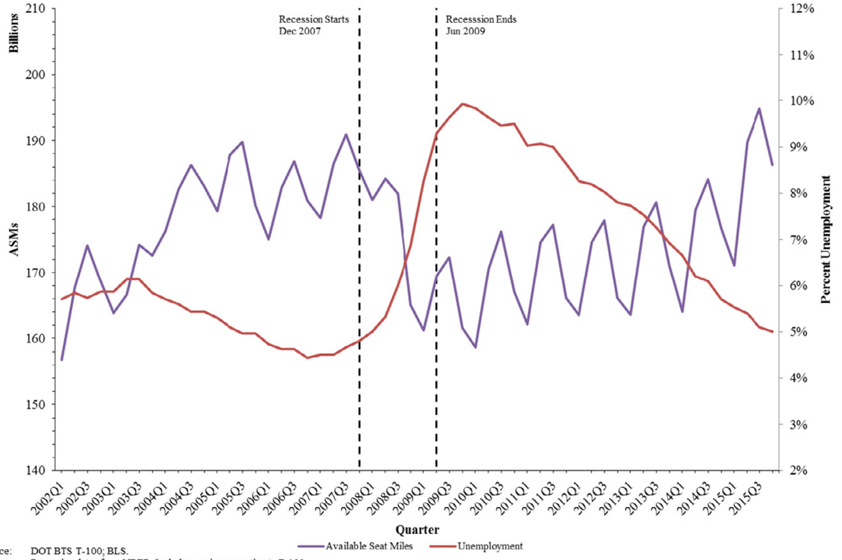
Source: DOT BTS DB1B; T-100; OAG.

Fig. 4. Total number of enplanements.

per passenger-mile for most of the last fifteen years, apart from the slump associated with the Great Recession. While fares appear to be increasing following each of the legacy carrier mergers, these increases fit a common pattern of fares returning back to their long-term equilibrium after the Great Recession. Additionally, even if increases in fares were associated with legacy carrier mergers, these increases could be consistent with both pro- and anti-competitive merger effects: in the pro-competitive merger, increased fares could reflect increased quality, while in the anti-competitive merger, increased fares could reflect carrier's anti-competitive exercise of market power. So, again, the more detailed econometric analysis we provide below—including a study of output effects—is required to disentangle the competing explanations.

Looking at the trend in the number of enplanements, as shown in Fig. 4, and accounting for variations in this measure due to seasonal patterns, indicates that the recent legacy airline mergers have not led to lower output. In particular, the decline in the number of passengers in 2009, which might appear to follow the Delta/Northwest merger, is clearly associated with the slowdown in economic activity during the Great Recession. And the fact that there were no long-term decreases in the number of passengers following the United/Continental and American/US Airways mergers indicates that there is no systematic relationship between mergers and lower output.

Finally, as shown in Fig. 5, which depicts the overall trend in available seat miles (a standard measure of airline capacity, where a single available seat mile represents one seat flown one mile), there is no evidence of a sustained long-term decline in capacity following recent legacy carrier mergers. To the contrary, there was a sharp decline in capacity in the months leading up to the Delta/Northwest merger, but just after the



Source: DOT BTS T-100; BLS.
Notes: Recession dates from NBER. Includes carriers reporting to T-100.

Fig. 5. Quarterly domestic available seat miles.

Delta/Northwest merger, the decline in capacity *ended*, and capacity began to grow again. The capacity growth remained steady before and after the United/Continental merger, and before and after the American/US Airways merger. Again this pattern is inconsistent with widespread harm to competition from the recent mergers.

Fig. 5 also plots airline capacity in the post-9/11 period against the unemployment rate and the timing of the Great Recession, both indicators of the overall health of the macro economy. Trends in capacity are highly correlated with these basic economic indicators. Three distinct sub-periods are clear from the chart—slight increases in capacity before and after the recession, with a sharp decline in capacity during the recession. Consistent with an important role for macroeconomic forces, the pattern in capacity is effectively the mirror image of the pattern in unemployment. Hence, it appears that, in recent years, capacity reductions have been associated with macroeconomic conditions, not with the recent mergers.

Though suggestive, the analysis of these industry-wide trends is far too broad to establish the merger's competitive effects one way or the other. Still, it is evident from the figures that macroeconomic conditions such as the Great Recession had a significant influence on the airline industry, and, therefore, that isolating merger effects requires controlling for macroeconomic trends. In the next section we employ a difference-in-differences regression analysis that allows us to control for macroeconomic (and other industry wide) trends and thus to isolate the merger effects by comparing the routes likely to be most affected by the mergers to control routes in which the mergers would have had, at most, a more diluted effect.

4. Methodology and data

2.1. Empirical methodology

Estimation of the effects of airline mergers on consumers is complicated by two facts. First, as illustrated above, fares are affected by many economic factors other than the number of competitors on a route and those factors may be changing over time. Because of this, a simple before-and-after examination of nominal fares on the routes affected by the merger risks attributing to the merger trends in fares that may have some other causes.[8]

Second, changes in nominal fares are not a guide to changes in consumer welfare when quality changes simultaneously. Knowing the effect of the merger on nominal fares, therefore, is not enough to tell us whether consumers are better or worse off, especially in an airline merger where there is a strong reason to believe (explained more fully below) that consolidation leads to higher-quality products.

In our study, we deal with both these complications in turn. First, we examine whether nominal fares have risen post-merger, but deal with the confounding influence of non-merger related changes in conditions by relying on the well-known "difference-in-differences" estimation technique (See, e.g., Ashenfelter and Card, 1985 and Card and Krueger, 1994). This is a standard econometric technique that does not rely on structural modeling of the effects of the merger on fares, but rather compares changes in fares on routes that should have been most affected by the merger to changes in fares on routes that likely would not have been affected by the merger (or at least on which any effect would be far more modest).[9] The routes that would not have been affected by the merger act as a control group to capture the general trends in fares. This approach allows us to account for the confounding effects of non-merger related changes in economic conditions, identifying the merger effects by relying on effects experienced only on overlap routes but not on control routes, with common changes across overlap and control routes attributed to non-merger related changes.

The difference-in-differences technique must be implemented carefully. Most basically, the affected (overlap) routes must be those that are likely to have experienced the competitive effects from the merger. And because the technique relies upon finding a good control group of routes—which capture what would have happened on the overlap routes but for the merger—one should test that the control group is appropriate and consider multiple possible controls groups to make sure findings are robust. In addition, the pre-

[8] Generally, one needs to account for inflation when examining changes in fares over time. The difference-in-differences approach discussed below implements such adjustment.

[9] Even if the control routes were affected to a small degree by the merger, as long as the overlap routes were *most affected*—as seems clear given that they are the routes on which the merging parties competed pre-merger and they are generally at the heart of the combined network—then the logic goes through. To the extent the merger had anti-competitive net effects, the overlap routes should see fare increases and output decreases relative to other routes. To the extent it had pro-competitive net effects, the reverse result would be expected.

and post-merger periods must reflect periods of independent decision-making and joint decision-making by the merging parties, respectively, so that the effect of the merger on decision variables such as fare is laid bare. In our analysis, we take care on both dimensions *and* we present several sensitivity analyses that indicate that our results are not driven by specific decisions on either of these dimensions.

Second, we account for the fact that, even if nominal fares have risen, quality-adjusted fares may have fallen.[10] As usual, one cannot measure quality-adjusted fares directly, so the obvious approach is to focus on quantity: Given that consumer demand depends on quality-adjusted fares and demand curves slope downward, greater output implies lower quality-adjusted fares. To this end, we examine changes in the number of passengers traveling on overlap routes as well as seat capacity on overlap routes, both of which should move inversely to changes in quality-adjusted fares. We use the same difference-in-difference technique described above to study changes in the number of passengers.

2.2. Data sources and time periods

Our primary data source is the Department of Transportation's Origin and Destination Survey (DB1B) database, which is a 10% sample of all domestic itineraries in each quarter for each year in our sample. The data contain information on origin, destination and connecting airports, marketing and operating carrier, quarter of travel, fare, and the number of passengers paying that fare.[11] We use these data to identify connecting overlaps (as described below), as well as to calculate fares and the number of passengers on each origin and destination pair in each quarter.

We use airline schedules from the Official Airline Guide (OAG), which publishes a complete set of scheduled flights for all airlines between all U.S. airports, to identify nonstop carriers on each route and thus to identify nonstop overlaps, i.e., routes where both merging carriers provided nonstop service before the merger.

We use the T100 (Form 41) database from the Bureau of Transportation Statistics, which reports the number of available seats by airline and airport-pair segment for all domestic passenger flights in the U.S., to identify capacity on overlap and control routes.

To define pre- and post-merger time periods, we take two years of data before and after each merger's approval by the Department of Justice, and we exclude the quarter of the merger's approval from the analysis (Q4 2008 for the Delta/Northwest merger, Q3 2010 for the United/Continental merger, and Q4 2013 for the American/US Airways merger). Thus, pre- and post-merger time periods for the Delta/Northwest merger are Q4 2006–Q3 2008 and Q1 2009–Q4 2010, pre- and post-merger time periods for the

[10] In a model of consumer utility maximization, one can construct a price index that reflects both quality and price in order to predict consumption decisions. That is what we mean by "quality adjusted fare".

[11] For simplicity we restrict the DB1B database to customer itineraries with at most one stop on each directional market, and we implement standard data cleaning steps when using these data. In particular, we drop itineraries marked as bulk or containing non-credible fares (as classified in the database), and itineraries with fares below $25 in economy class. Appendix contains other details on how we processed the DB1B dataset.

Table 1
Nonstop overlap routes.

Merger	2->1 Overlaps	3->2 Overlaps
I. Delta/Northwest	Cincinnati-Detroit	Atlanta-etroit
	Cincinnati-Minneapolis	Atlanta-Memphis
	Detroit-Salt Lake City	Atlanta-Minneapolis
	Minneapolis-Salt Lake City	
II. United / Continental		Cleveland-Denver
		Washington, D.C.-Houston
		Houston-San Francisco
III. American / USAirways	Charlotte-Dallas	Dallas-Philadelphia
	Charlotte-Miami	Miami-Phoenix
	Dallas-Phoenix	

United/Continental merger are Q3 2008–Q2 2010 and Q4 2010–Q3 2012, and pre- and post-merger time periods for the American/US Airways merger are Q3 2011–Q3 2013 and Q1 2014–Q4 2015.

2.3. Overlap and control routes

2.3.1. Details of nonstop analysis

To identify nonstop overlaps between the merging parties, we use OAG data for the week of July 9–15 in the year of the merger approval (2008 for Delta/Northwest, 2010 for United/Continental, and 2013 for American/US Airways). We count a carrier as a nonstop carrier if the carrier had at least 10 nonstop operations (five round-trips) on a given origin-destination pair in that week. Accordingly, nonstop overlaps are origin-destination combinations for which both merging parties had at least 10 total operations during this week.

To analyze the competitive effects from the merger, we focus on 2-to-1 and 3-to-2 overlaps, meaning overlaps on which at most one other carrier had 10 nonstop operations according to the OAG data.[12] Using the above criteria, we identify a total of seven 2-to-1 nonstop overlaps (four from the Delta/Northwest transaction, and three from the American/US Airways transaction) and eight 3-to-2 nonstop overlaps (three each from the Delta/Northwest and United/Continental transaction, and two from the American/US Airways transaction) from the previous mergers. Table 1 lists each of these overlap routes.

We identify separate control routes for the 2-to-1and 3-to-2 nonstop overlaps in each merger. The control routes in each case are routes that are not nonstop or connecting overlaps for any of the three mergers,[13] and that have the same number of nonstop carriers

[12] Recent economic literature indicates that adding a third nonstop legacy carrier has no statistically significant effect on fares (See, e.g., Brueckner, Lee and Singer, 2013). In our sensitivity analysis, we also include 4-to-3 overlaps in the analysis.

[13] For example, nonstop control routes for the Delta/Northwest merger cannot be United/Continental or American/US Airways nonstop or connecting overlap routes and so on.

as the corresponding set of nonstop overlaps in the pre-merger period.[14] Requiring that the control routes have the same number of nonstop carriers as the overlap routes in the pre-merger period helps to ensure that the control routes are reasonably comparable to the overlap routes, including a similar pre-merger competitive structure.[15]

Once we match control routes to each set of nonstop overlap routes (e.g., 2-to-1 nonstop overlaps for the Delta/Northwest transaction, or 3-to-2 nonstop overlaps for the American/US Airways transaction), we pool the data for the nonstop overlap routes and the corresponding control routes into one sample, across the three mergers, which we use to run our pooled regressions for nonstop overlaps.[16] We include route fixed effects in all of the regressions. We weight the regressions by the total number of passengers (summing across all quarters in our analysis) on each route to put more weight on the relatively larger routes in our estimates.[17,18]

Table 2 provides descriptive statistics for nonstop overlap and control routes. This table illustrates how the difference-in-differences method works: while average fares on nonstop overlaps for the Delta/Northwest merger did not change much between the post- and pre-merger periods, average fares on control routes, selected as discussed above, increased by about 2%. Therefore, fares on nonstop routes appear to have declined after the merger relatively to the trends on fares on control routes. Similarly, fares on overlap routes for the American/US Airways mergers declined between the post- and pre-merger time periods relative to the control routes. In contrast, fares on United/Continental overlap routes appear to have increased relative to fares on the corresponding control routes. In the next section we will identify whether these patterns are confirmed by our regression analysis through which we control for other factors that may have affected fares.

Table 2 also provides an insight into the relationship between output and capacity on nonstop routes. The fact that the number of seats (capacity) on nonstop routes is on average more than double the number of passengers (output) shows the importance of connecting passengers on these routes. Note that our nonstop route analysis captures passenger traffic on a nonstop route from airport A to airport B, but does not capture

[14] For example, nonstop control routes for 2-to-1 nonstop overlaps in the Delta/Northwest scenario have two nonstop carriers in the pre-merger period.

[15] As we discuss later, we conduct more formal testing to ensure that the trends in fares and output on nonstop overlaps and on the corresponding sets of control routes are not statistically different in each of the three pre-merger periods, and show that, if anything, our selected group of control routes lead our estimation results to be overly conservative.

[16] We also pool 2-to-1 and 3-to-2 routes into one sample, though in a later section, we check that this pooling has no material effect on our conclusions.

[17] One rationale for weighting is that the fares in the DB1B database come from a 10 percent sample of tickets, meaning that smaller routes will have noisier fare estimates. For a discussion of other rationales, (see Solon, Haider and Wooldridge, 2015). Note that the weighting leads to three mergers having varying overall weight in the pooled regression estimates; our substantive conclusions remain unchanged if we force mergers to have equal overall weight, but continue weighting the routes within each merger by number of passengers.

[18] Because we use the total number of passengers for each route, our weights do not vary across quarters for a given route. In this way, we avoid any concerns that the weights are endogenous. Any differences in the characteristics of different-sized routes are captured by the route fixed effects, meaning that constant route weights are uncorrelated with the error term by construction.

Table 2
Descriptive statistics for nonstop overlap and control routes.

	Variable	Pre-merger	Post-merger	Percentage difference (%)
I. Delta/Northwest				
Overlaps (2⟶1 routes: 4; 3⟶2 routes: 3)				
	Average price	$177.75	$177.35	−0.2
	Total passengers per day each way	1983	1916	−3.4
	Total seats per day each way	7688	8370	8.9
Control routes (2⟶1 routes: 385; 3⟶2 routes: 145)				
	Average price	$163.28	$166.97	2.3
	Total passengers per day each way	2,03,035	1,83,750	−9.5
	Total seats per day each way	5,54,517	5,06,196	−8.7
II. United/Continental				
Overlaps (2⟶1 routes: 0; 3⟶2 routes: 3)				
	Average price	$232.27	$272.19	17.2
	Total passengers per day each way	1742	1810	3.9
	Total seats per day each way	4218	4904	16.3
Control routes (2⟶1 routes: 0; 3⟶2 routes: 140)				
	Average price	$164.01	$187.59	14.4
	Total passengers per day each way	81,453	83,207	2.2
	Total seats per day each way	2,13,799	2,11,337	−1.2
III. American/US Airways				
Overlaps (2⟶1 routes: 3; 3⟶2 routes: 2)				
	Average price	$246.33	$229.60	−6.8
	Total passengers per day each way	2217	2807	26.6
	Total seats per day each way	8173	9670	18.3
Control routes (2⟶1 routes: 317; 3⟶2 routes: 138)				
	Average price	$199.10	$207.33	4.1
	Total passengers per day each way	1,60,927	1,72,670	7.3
	Total seats per day each way	4,40,334	4,50,353	2.3

connecting traffic on itineraries from airport C to airport B *via* airport A. The network considerations that airlines must make to accommodate this connecting traffic generally drive the capacity on nonstop routes well above the nonstop-only output on those routes. This makes the interpretation of the merger effects on capacity less straightforward because an increase in capacity on a route benefits both nonstop and connecting passengers.

2.3.2. Details of connecting analysis

To identify connecting overlaps, we use the DB1B dataset. We define a connecting carrier on a given route as a carrier with at least 10% of total passenger traffic. Connecting overlaps are origin-destination pairs that satisfy the following criteria: the merging parties did not both provide nonstop service in pre-merger time period,[19] each of the merging parties had at least a 10% passenger share on a given route in the pre-merger period, and together the merging parties had at least a 40% passenger share pre-merger.

[19] "Nonstop" service is defined using OAG data as described above.

The 40% restriction insures that results are not biased away from finding effects due to the inclusion of routes with minimal overlap. We understand that this definition of connecting overlaps is similar to the definition the Department of Justice has adopted in its previous analyses of airline mergers. Notably, under this definition, we include both nonstop/connecting (in which one of the merging parties provides nonstop service and the other provides connecting service) and connecting/connecting overlaps in our connecting overlap category.

Similar to control routes for nonstop overlaps, we define separate control routes for the 2-to-1 and 3-to-2 connecting overlaps in each merger. Control routes for connecting overlaps are routes where the following conditions are satisfied: (a) the route is not a nonstop or connecting overlap for any of the three mergers; (b) there are the same number of carriers with at least 10% share as the corresponding set of connecting overlap routes (i.e., control routes for 3-to-2 connecting overlap route have 3 carriers pre-merger, meaning 3 carriers with at least 10% of passenger traffic); and (c) the number of nonstop carriers on the route (as computed from OAG data, as described above) is smaller than the total number of carriers on the route (meaning at least one of the carriers with 10% share on the route is not a nonstop carrier).[20]

Once we match control routes to each set of connecting overlap routes, we pool the data for the connecting overlap routes and the corresponding control routes into one sample, which we use to run our regressions for connecting overlaps.

One potential issue that arises for connecting overlap and the associated control routes is that some of the routes may have very little traffic.[21] Not only may very small routes be economcally different from larger routes, but the fact that the DB1B data is only a 10% sample of all tickets creates a strong possibility that fares and traffic levels on such small routes are noisy and subject to random quarter-to-quarter fluctuations.[22] In our analysis, we take two steps to address this. First, we limit the connecting overlap and control routes included in our study to those with at least 20 passengers daily each way (PDEW). Second, we weight the connecting regressions by the total number of passengers (summing across all quarters in our analysis) on each route to put more weight on the relatively larger routes in our estimates. In our sensitivity runs, we present results using a 10 (rather than 20) PDEW screen and for unweighted connecting regressions to show that our conclusions do not depend on these specific choices.

Using the definitions in this section (including the requirement for an overlap route and the 20 PDEW screen), we identify 18 2-to-1 connecting overlaps (nine each from the Delta/Northwest and American/US Airways transactions) and 116 3-to-2 connecting overlaps (51 from the Delta/Northwest transaction, 13 from the United/Continental

[20] Similar to the nonstop overlap analysis, below we present formal test results that ensure that our control routes are appropriate.

[21] The issue of routes with very few passengers does not arise for nonstop overlaps or their associated controls, which is not surprising given that they all have at least two nonstop carriers in the pre-meger time period.

[22] To reflect the possibility of such heteroscedasticity, we use robust standard errors in all analyses.

Table 3
Descriptive statistics for connecting overlap and control routes.

Variable	Pre-merger	Post-merger	Percentage difference (%)
I. Delta/Northwest			
Overlaps (2⟶1 routes: 9; 3⟶2 routes: 51)			
Average price	\$220.53	\$202.56	−8.2
Total passengers per day each way	2143	2215	3.4
Control routes (2⟶1 routes: 536; 3⟶2 routes: 606)			
Average price	\$205.01	\$199.50	−2.7
Total passengers per day each way	96,784	91,930	−5.0
II. United/Continental			
Overlaps (2⟶1 routes: 0; 3⟶2 routes: 13)			
Average price	\$253.18	\$300.85	18.8
Total passengers per day each way	870	864	−0.6
Control routes (2⟶1 routes: 0; 3⟶2 routes: 639)			
Average price	\$200.12	\$226.52	13.2
Total passengers per day each way	58,289	59,775	2.5
III. American/US Airways			
Overlaps (2⟶1 routes: 9; 3⟶2 routes: 52)			
Average price	\$274.78	\$289.07	5.2
Total passengers per day each way	4389	4679	6.6
Control routes (2⟶1 routes: 556; 3⟶2 routes: 687)			
Average price	\$233.93	\$244.69	4.6
Total passengers per day each way	1,08,624	1,13,622	4.6

transaction, and 52 from the American/US Airways transaction) to use in our base analysis.

Table 3 provides descriptive statistics for connecting overlap and control routes.[23] The fares on connecting overlap routes for the Delta/Northwest merger appear to have declined between the post- and pre-merger periods by more than the fares on the corresponding control routes. In contrast, fares on connecting overlap routes for United/Continental and American/US Airways mergers appear to have increased post-merger relative to the corresponding set of control routes. Again, the regression analysis will confirm whether these patterns hold up in a more rigorous setting and, if so, whether they are statistically significant.

We now turn to describing our regression model specification, which will allow us to control for additional factors that affected fares and output and thus to identify the effect of the mergers on these variables with more rigor.

[23] Similar to the nonstop analysis, we pool overlap and connecting routes from three mergers into one sample. We also pool both 2-to-1 and 3-to-2 routes into one sample, though in a later section, we check that this pooling has no material effect on our conclusions. Note that because there were no 2-to-1 connecting overlaps in the United/Continental merger, we also ran a version of the regression in which we dropped the 2-to-1 control routes from the sample for the United/Continental merger and this had no substantive effect on our results.

2.4. Model specification

Our analysis examines a series of regression models of the following form:

$$Y_{it} = \beta_1 \mathrm{Merger}_i \mathrm{Post}_t + \beta_2 \mathrm{PercentNonstop}_{it} + \delta i + \theta t + \varepsilon_{it},$$

where an observation is a city-pair i in a particular quarter t.[24]

Our main independent variable of interest is a dummy variable, represented by term $Merger_i Post_t$ in the equation above, that takes a value of 1 for overlap routes in the post-merger period, and zero otherwise. This variable is the main tool of the difference-in-differences estimation approach. The reason for this is that—because we also include city-pair fixed effects δi and year-quarter fixed effects θt—the estimated coefficient on this variable measures the incremental effect of the merger on the dependent variable on overlap routes *relative* to how the dependent variable has changed on control routes between the pre-merger and post-merger time periods.[25] In addition, following previous studies of pricing in the airline industry, we include a variable measuring the percentage of nonstop passengers on a given route as an additional control in all regressions.[26,27] For consistency, we include this variable both in the regressions studying merger effects on fares and in the regressions studying merger effects on number of passengers and capacity. The Appendix Tables 1 and 2 show that omitting this variable does not alter our conclusions that recent legacy airline mergers had pro-competitive effects on consumers.[28]

Our analysis examines a series of regression models with different dependent variables Y_{it}:

- Logarithm of average nominal fare on a given route-quarter. Consistent with standard practice in the economics literature, we focus on the effect of the merger on nominal fares across *all* carriers on the route, not just merging-party fares. Focusing on merging-party (rather than market-wide) fares could be inappropriate since a

[24] We follow city-pair groupings, which match those in Brueckner, Lee and Singer (2013) other than splitting Cincinnati (CVG) and Dayton (DAY) into separate groupings.

[25] The city-pair fixed effects account for time invariant unobservable variables that may have a differential effect across different routes. For instance, fares could be higher on routes that originate in airports located in more expensive cities. The year/quarter fixed effects account for unobservable variables that affect fares on all routes simultaneously. For instance, increases in fuel costs or general inflation may lead to higher fares on all routes. With these controls in place, the post-merger dummy on overlap routes measures the effect of the merger on overlap routes relative to the contemporaneous change on control routes.

[26] See, e.g., Borenstein (1989), who studies airline pricing and controls for percent of nonstop passengers by using average number of change-of-plane stops on the observed airline routes. (See also Orlov 2011). The likely effect of the percent non-stop variable on pricing is ambiguous because nonstop operation is less costly to the airlines, and yet it provides higher quality and convenience for consumers. We find that higher percent of nonstop passengers on a given route is associated with lower fares. See Appendix Tables 1 and 2.

[27] Note that both lack of data and lack of variation across routes prevent us from studying how other potential factors (e.g., baggage fees) affect fares. However, to the extent such factors have a merger-specific effect, the effect would be captured in the regressions for output, which provides a complete metric of quality-adjusted fares.

[28] The results in the Appendix show that when the variable measuring the percentage of nonstop passengers on a given route is omitted from our regressions, the statistically significant negative merger effect on nonstop average fare on overlap routes becomes marginally statistically insignificant, but the positive and statistically significant effects of a merger on output and capacity remain.

successful, pro-competitive merger may cause the merging parties, in particular, to attract relatively more high-fare business passengers, thus increasing the observed average fares received by the merging parties, even with no change in their pricing rules. *The results of this regression indicate the percentage change in average nominal fares on overlap routes between the pre-merger and post-merger periods relative to theage change in average nominal fares on control routes.*

- Logarithm of the 90th percentile nominal fare on a given route-quarter (as a proxy for fares paid by business travelers). As such, *the results of this regression are taken to indicate the percentage change in nominal fares paid by business travelers on overlap routes between the pre-merger and post-merger periods relative to the percentage change in nominal fares paid by business travelers on control routes.*
- Logarithm of the total number of passengers flying on the route in each quarter.[29] *The results of this regression indicate the percentage change in total traffic on overlap routes between the pre-merger and post-merger periods relative to the percentage change in total traffic on control routes.*
- Logarithm of the total number of available seats on the route in each quarter. *The results of this regression indicate the percentage change in total seat capacity on overlap routes between the pre-merger and post-merger periods relative to the percentage change in total seat capacity on control routes.* This metric is only available for nonstop routes.
- Finally, we use weighted regressions, weighting the output regressions by total traffic on a route and fare regressions by total revenue on a route.[30]

5. Estimation results

5.1. Pooled regression results

Table 4 reports results for nonstop overlaps, pooling all three recent legacy carrier mergers.[31] The results thus represent an average effect of the three mergers on fare, output and capacity. Each coefficient reported in the table can be interpreted as the approximate merger-induced change in the variable in question, in percentage terms. Given that competitive effects from an airline merger are likely to be most pronounced on nonstop overlaps, we consider our nonstop results to be the most important results in the paper.

[29] As mentioned above, the effect of a merger on consumer welfare in any particular antitrust market is determined by changes in fare and output across all carriers in the market, not the effects on a single carrier. Only by focusing on market-wide fares and output can one assess the full post-merger competitive process. For example, to the extent that carriers currently serving a route react to merger-induced changes by cutting fares, improving quality, or expanding—or to the extent that the merger induces entry by new carriers—these changes would not be captured merging-party-specific metrics, meaning that these metrics are necessarily incomplete.

[30] We use constant weights for each route, determined by the average pre-merger traffic (for output regressions) and revenue (for fare regression). Because our fare regressions focus on market average fare, we weight fare regressions by total revenues on the route rather than merging party revenues.

[31] The detailed regression output for the corresponding regressions is presented in the Appendix.

Table 4
Pooled nonstop overlap results.

Dependent variable	Merger effect nonstop overlaps
Log (Avg. Fare)	−0.063**
	[0.026]
	(18,123)
Log (90th percentile Fare)	−0.030
	[0.020]
	(18,123)
Log (Nr. Passengers)	0.120***
	[0.032]
	(18,123)
Log (Nr. T-100 seats)	0.236***
	[0.033]
	(18,080)

Source: OAG, DOT DB1B Data, DOT T-100 Data.
Notes: Robust standard errors, clustered by route, are in brackets.
Models weighted by total passengers on route for all periods.
Nonstop overlaps defined as routes where both merging parties had at least 5 roundtrips in the week of July 9–15 of the merger year.
***/**/* denote significance of coefficients at 1%/5%/10% level of significance.

The implications from the table are clear: When considered collectively, the recent legacy mergers have been associated with pro-competitive effects on affected routes relative to unaffected routes.

- On average, following the mergers, there were substantial fare decreases across all routes affected by the mergers relative to unaffected routes, averaging 6.3% on routes where both merging parties were providing nonstop service.
- At the same time, output increased on average by 12.0% on routes where both merging parties were providing nonstop service relative to control routes.
- There was also a statistically significant capacity increase of 23.6% on overlap routes relative to non-overlap routes.

In combination, these results for average fares, output and capacity are strongly supportive of pro-competitive network effects, with associated output expansion on the overlap routes that are at the heart of the combined network. Taken together, these results show that the mergers resulted in decreases in quality-adjusted fares on nonstop overlap routes, relative to non-overlap routes.

We note that legacy mergers had a bigger effect on capacity than on the number of passengers on nonstop overlaps. This finding indicates that merging carriers allocated some of the capacity on nonstop overlaps for passengers that use these routes to connect to their ultimate destinations, thus also benefiting those passengers.

Table 5 shows the result of the connecting overlap analysis on the pooled sample of all three mergers.[32] The results, while less pronounced, support the conclusion that the

[32] The detailed regression output for the corresponding regressions is presented in the Appendix.

Table 5
Pooled connecting overlap results.

Dependent variable	Merger effect connecting overlaps
Log (Avg. fare)	0.002
	[0.011]
	(50,514)
Log (90th Percentile fare)	−0.004
	[0.013]
	(50,514)
Log (Nr. passengers)	0.012
	[0.014]
	(50,514)

Source: OAG, DOT DB1B Data.
Notes: Robust standard errors, clustered by route, are in brackets.
Models weighted by total passengers on route for all periods.
Connecting overlaps defined as routes where both merging parties had at least 10% share of passengers and combined they had at least 40% share in the pre-merger period.
***/**/* denote significance of coefficients at 1%/5%/10% level of significance.

three legacy airline mergers had no anti-competitive effects. The main takeaway from the combined connecting results is that the there is no detectable anti-competitive effect from the three recent legacy airline mergers on output or fares on connecting overlaps

5.2. Individual regression results

We also find that the results in the pooled regressions hold even when we evaluate each legacy airline merger individually. In particular, Table 6 shows the results of the difference-in-differences analysis for nonstop overlaps separately for each legacy airline merger.[33] These results indicate that none of the three mergers had anti-competitive effects. Quite the opposite, the Delta/Northwest and American/US Airways mergers appear to have led to large fare reductions on affected routes, combined with large output and capacity increases. On average, following the mergers and relative to unaffected routes, the fares have declined by 4.4% and 12.3%, respectively, on Delta/Northwest and American/US Airways nonstop overlap routes, and the output on these routes has increased by 6.6% and 20.2%, respectively. Similarly, the capacity has increased by 25.5% and 19.6% on Delta/Northwest and American/US Airways nonstop overlap routes, respectively.

In the case of the United/Continental merger, although there was no statistically significant fare reduction, there were large statistically significant increases in output and capacity on affected routes, which have increased (relative to unaffected routes) by 7.2 and 26.4%, respectively, indicating a reduction in quality-adjusted fares.

Thus, we conclude that each of the three recent legacy mergers resulted in decreases in quality-adjusted fares on nonstop overlap routes, relative to nonstop non-overlap routes,

[33] The individual merger regressions each use that merger-specific set of control routes.

Table 6
Separate nonstop overlap results.

Dependent variable	DL/NW merger effect nonstop overlaps	UA/CO merger effect nonstop overlaps	AA/US merger effect nonstop overlaps
Log (Avg. fare)	−0.044**	−0.013	−0.123***
	[0.021]	[0.013]	[0.042]
	(8554)	(2267)	(7302)
Log (90th percentile Fare)	−0.023	−0.020	−0.057
	[0.041]	[0.021]	[0.042]
	(8554)	(2267)	(7302)
Log (Nr. passengers)	0.066**	0.072*	0.202***
	[0.031]	[0.040]	[0.061]
	(8554)	(2267)	(7302)
Log (Nr. T-100 seats)	0.255***	0.264***	0.196***
	[0.070]	[0.027]	[0.057]
	(8528)	(2262)	(7290)

Source: OAG, DOT DB1B Data, DOT T-100 Data.
Notes: Robust standard errors, clustered by route, are in brackets.
Models weighted by total passengers on route for all periods.
Nonstop overlaps defined as routes where both merging parties had at least 5 roundtrips in the week of July 9–15 of the merger year.
***/**/* denote significance of coefficients at 1%/5%/10% level of significance.

with the output and capacity growth on the routes at the heart of the combined network being strongly supportive of network benefits from the mergers.

The fact that nominal fare effects for the United/Continental merger are not statistically significant—and thus that results are more mixed for this merger than the other two—is consistent with conventional wisdom about the merger. In particular, as was well publicized, the United-Continental merger faced extensive integration difficulties, leading analysts to conclude that the benefits that could otherwise have been achieved by the merger were "squandered.[34]" Many of the problems appear to derive from labor integration issues,[35] as well as from the issues in integrating reservation systems.[36]

[34] Vicki Bryan, a senior bond analyst at New York- based Gimme Credit LLC, quoted in "United Vows Steps to Boost Sales as Profit Trails Views," Bloomberg, October 24, 2013, http://www.bloomberg.com/news/2013-10-24/united-vows-steps-to-boost-sales-as-profit-trails-views.html, ("'United has not just been going the wrong way profit-wise, it seems to have squandered so far the promising potential that had seemed so obvious' with the 2010 merger that combined the networks of United and Continental Airlines"). For other discussion of the United-Continental integration difficulties see The Economist, "The United-Continental Merger: Truly United?", September 9, 2013, http://www.economist.com/blogs/gulliver/2013/09/united-continental-merger.

[35] United stated in its 2012 annual report that "the successful integration of United and Continental and achievement of the anticipated benefits of the combined company depend in part on integrating United and Continental employee groups and maintaining productive employee relations" and that "[a] delay in our failure to integrate the United and Continental employee groups presents the potential for delays in achieving expected Merger synergies, increased operating costs and labor disputes that could adversely affect our operations." (United Airlines Form 10-K for the Year Ending December 31, 2012, p. 18, http://www.sec.gov/Archives/edgar/data/100517/000119312513074391/d436512d10k.htm.)

[36] CEO Jeff Smisek specifically named the reservations system as a very difficult part of the integration. (*The Charlie Rose Show*, PBS, August 9, 2013 "Conversation with Ashton Kutcher; Conversation with Jeff Smisek" (Transcript provided by Dow Jones), p. 12.)

Table 7
Separate connecting overlap results.

Dependent variable	DL/NW merger effect connecting overlaps	UA/CO merger effect connecting overlaps	AA/US merger effect connecting overlaps
Log (Avg. fare)	−0.037*	0.036	0.010
	[0.020]	[0.027]	[0.014]
	(19,230)	(10,432)	(20,852)
Log (90th percentile Fare)	−0.046**	0.003	0.012
	[0.019]	[0.046]	[0.016]
	(19,230)	(10,432)	(20,852)
Log (Nr. passengers)	0.010	0.012	0.017
	[0.025]	[0.048]	[0.020]
	(19,230)	(10,432)	(20,852)

Source: OAG, DOT DB1B Data.
Notes: Robust standard errors, clustered by route, are in brackets.
Models weighted by total passengers on route for all periods.
Connecting overlaps defined as routes where both merging parties had at least 10% share of passengers and combined they had at least 40% share in the pre-merger period.
***/**/* denote significance of coefficients at 1%/5%/10% level of significance.

Connecting overlap results for each merger individually are also each consistent with the pooled results for connecting routes. Table 7 presents the results for connecting overlaps for each of the mergers, separately. Like the pooled regression results in Table 5, the main result apparent from Table 7 is the lack of fare and output effects, and therefore the lack of anti-competitive effect due to each of the mergers. The Delta/Northwest merger resulted in a small negative effect of 3.7% on nominal business fares. However, other nominal fare effects are insignificant. All of the coefficients on passenger traffic are positive, but not statistically significant. Overall, the results for the individual mergers show no consistent pattern of anti-competitive effects for connecting overlaps, relative to non-overlap connecting routes, but also no strong support for pro-competitive effects. The lack of pro-competitive effects may not be surprising: as noted above, the merger benefits hold for the nonstop overlap that are at the heart of the combined network and thus experience capacity/output expansions due to network benefits, but these benefits do not appear to carry through for connecting overlaps.

5.3. Robustness checks and sensitivity analyses

To confirm the robustness of our results, we have also run a variety of other alternative specifications of the regressions. Our sensitivity analyses deal, among other things, with how we defined the affected (overlap) routes, how we defined pre- and post-merger time periods, and our selection of control routes.[37] Although there is naturally slight variation in results between various specifications, taken as whole, these sensitivity results strongly

[37] Mehta and Miller (2012) emphasize the importance of checking alternative controls in difference-in-differences studies of airline mergers in particular, including filters based on the number of passengers on the route.

confirm our conclusion that the recent legacy mergers were not associated with anti-competitive outcomes.

First, we confirmed that the sets of control routes we use in our nonstop and, separately, connecting overlap analyses are appropriate for our differences-in-differences method. In particular, we have confirmed that the trends in the fares and output on nonstop and connecting overlaps and on the corresponding sets of control routes are not statistically different in each of the three pre-merger periods, with some exceptions, which upon further examination led us to conclude that our results are overly conservative.

In particular, separately for each merger in the pre-merger time period— and separately for nonstop and connecting routes—we ran regressions of fares and passengers (both in logarithms) on route fixed effects, quarter fixed effects, and quarter fixed effects interacted with the dummy variable for control routes. We then tested the joint hypothesis that the interactions of quarter fixed effects with the dummy variable for control routes are jointly zero, and we could not reject this hypothesis at the 5% significance level for all but four of the twelve regressions. For these four cases, we repeated the regression using the pre-merger time period, but instead of interacting the dummy variable for control routes with the quarter fixed effects, we interacted it with a time trend to determine if a difference in time trend would bias our results. Based on the coefficient estimates for the interaction, in three out of four cases, the control routes have trends that are more favorable to consumers (in terms of fares or output, as is relevant in the specific regression, using the 5% level of significance), and in the fourth case there is no statistically significant difference in trend between control and treatment routes. Hence, to the extent there are statistically significant trend differences between the treatment and control routes, they tend to bias results toward a finding of anti-competitive merger effects, thus bolstering our finding of no such effect, and if anything, making our results conservative.

Table 8a and 8b present the results from a variety of alternative versions of our pooled nonstop regressions.[38] The first column in Table 8a repeats the results of our base pooled regression. In the next two columns we split the estimation sample into two subsamples of routes that had either two or three nonstop carriers before the merger. The results indicate that the mergers had pro-competitive effects for both types of routes. Then, in the following column, we expand our base model to include routes that had four nonstop carriers before the merger (along with routes with two or three nonstop carriers).

In the next two columns, we alter the threshold for a nonstop carrier to count as “present” on a route (and thus alter the set of overlaps and the number of carriers on each route) from five round-trips in a week to three or seven round-trips, respectively.

In the last three columns, we alter the time periods used to evaluate the regression. First, we use a time period of one year pre- and post-merger rather than two years pre- and post-merger. In the following two columns, we consider, respectively, two and three

[38] The results of similar sensitivity regressions for individual mergers are presented in Appendix.

years before and after the merger but exclude the first year after the merger from the post-merger time period, to allow time for the effects of the merger to come to fruition.[39]

In the second column in Table 8b, we replace the dummy variable in the regression with a measure of change in concentration due to the merger, in this case change in HHI between post- and pre-merger, which we divide by 5000 (the maximum change possible from a merger) to arrive to a measure that takes values between 0 and 1.[40] In the following column, we show the results of unweighted OLS regressions.

In the next four columns, we add additional filters on the set of control routes.[41] First, we add an "LCC filter" requiring that control routes had the same number of LCCs in the pre-merger period as the overlap route. Second, we add a "pax filter" requiring that control routes must carry an aggregate number of passengers greater than or equal to 75% of the least-travelled corresponding overlap route and less than or equal to 125% of the most travelled corresponding overlap route. Third, we add a "distance filter" to our base regression requiring that control routes must span a distance greater than or equal to 75% of the shortest corresponding overlap route and less than or equal to 125% of the longest corresponding overlap route. Finally, we add an "origin-destination filter" requiring that control routes must share an origin or a destination with a corresponding overlap route.

This broad set of alternative specifications provides strong support for our conclusions regarding nonstop overlaps. *Most importantly, total output increases by a statistically significant amount—of at least 8.7%—in all specifications. Similarly, total capacity increases by a statistically significant amount—of at least 14.3%—across all specifications.* Hence, we find support for lower quality-adjusted fares across *all* specifications.

Table 9a and 9b present the results from a variety of alternative versions of our connecting regressions. The first column in Table 9a repeats the results of our base pooled regression. In the next two columns we split the estimation sample into two subsamples of routes that had either two or three carriers before the merger. The results indicate that the mergers had pro-competitive effects for 2-to-1 connecting overlaps. In the following column, we expand the sample to include routes that had four carriers before the merger (along with routes that had two or three carriers)

In the next column, we alter the threshold for presence as a connecting carrier on a route to a minimum share of five (rather than ten)%, and alter the definition of a connecting overlap to at least 5% share for each merging party in the pre-merger period and a combined share of at least 30 (rather than 40)%. In the following column, we reduce the PDEW requirement for inclusion in the regression to 10 (from 20).

[39] For the American/US Airways merger, there are only ten quarters of data available after the merger; therefore, we can only use six quarters of data for the post-merger period.

[40] Using this alternative measure allows us to expand the set of treatment routes.

[41] The approach of using additional filters to select control routes is similar in spirit to the synthetic control method (See Abadie and Gardeazabal, 2003 and Abadie, Diamond and Hainmueller, 2010). The synthetic control methodology requires one synthetic control for each treated unit, i.e., an overlap route.Instead, in our paper we identify many control routes that match the group of treatment (i.e., overlap) routes on the important dimension of the number of pre-merger competitors, and we show that our results are highly robust to further restriction of the control group.

Table 8a
Sensitivity results for nonstop overlaps.

Dependent variable	Base	2→1	3→2	4→3, 3→2, 2→1	3 Round-trips	7 Round-trips	+/−1 Year	+/−2 Year, Exc. post year	+/−3 Year, Exc. post year
Log [Avg. fare]	-0.063^{**}	-0.113^{**}	-0.053^{**}	-0.040^{*}	-0.062^{**}	-0.055^{**}	−0.044	-0.067^{***}	-0.044^{*}
	[0.026]	[0.055]	[0.024]	[0.021]	[0.026]	[0.025]	[0.029]	[0.026]	[0.025]
	(18,123)	(11,264)	(6859)	(20,766)	(18,786)	(16,983)	(9039)	(13,592)	(20,827)
Log [90th percentile Fare]	−0.030	−0.061	−0.025	−0.035	−0.029	−0.015	−0.021	−0.032	−0.040
	[0.020]	[0.047]	[0.021]	[0.028]	[0.020]	[0.026]	[0.025]	[0.027]	[0.030]
	(18,123)	(11,264)	(6859)	(20,766)	(18,786)	(16,983)	(9039)	(13,592)	(20,827)
Log [Nr. passengers]	0.120^{***}	0.190^{***}	0.087^{***}	0.098^{***}	0.121^{***}	0.093^{***}	0.099^{***}	0.124^{***}	0.141^{***}
	[0.032]	[0.066]	[0.031]	[0.024]	[0.032]	[0.031]	[0.035]	[0.035]	[0.033]
	(18,123)	(11,264)	(6859)	(20,766)	(18,786)	(16,983)	(9039)	(13,592)	(20,827)
Log [Nr. T-100 seats]	0.236^{***}	0.170^{**}	0.236^{***}	0.143^{***}	0.237^{***}	0.189^{***}	0.188^{***}	0.254^{***}	0.284^{***}
	[0.033]	[0.079]	[0.024]	[0.025]	[0.034]	[0.036]	[0.028]	[0.044]	[0.042]
	(18,080)	(11,230)	(6850)	(20,715)	(18,724)	(16,943)	(9019)	(13,561)	(19,842)

Source: OAG, DOT DB1B Data, DOT T-100 Data.
Notes: Robust standard errors, clustered by route, are in brackets.
Number of observations in the regression in parentheses.
Unless noted otherwise, regressions weighted by total passengers on route for all periods.
Unless noted otherwise, nonstop overlaps defined as routes where both merging parties had at least 5 roundtrips in the week of July 9–15 of the merger year.
$^{***}/^{**}/^{*}$ denote significance of coefficients at 1%/5%/10% level of significance.

Table 8b
Sensitivity results for nonstop overlaps.

Dependent variable	Base	HHI dummy	Non-weighted	LCC filter	Pax filter	Distance filter	OD filter	Demo
Log [Avg. fare]	−0.063**	−0.251***	−0.044*	−0.051**	−0.059**	−0.046*	−0.045*	−0.063**
	[0.026]	[0.054]	[0.023]	[0.024]	[0.027]	[0.026]	[0.026]	[0.026]
	(18,123)	(18,117)	(18,123)	(8081)	(8480)	(10,684)	(3856)	(17,632)
Log [90th percentile fare]	−0.030	−0.200***	−0.030	−0.019	−0.027	−0.016	−0.015	−0.034
	[0.020]	[0.061]	[0.030]	[0.020]	[0.023]	[0.020]	[0.026]	[0.021]
	(18,123)	(18,117)	(18,123)	(8081)	(8480)	(10,684)	(3856)	(17,632)
Log [Nr. passengers]	0.120***	0.339***	0.131***	0.116***	0.112***	0.095***	0.112***	0.126***
	[0.032]	[0.052]	[0.047]	[0.031]	[0.034]	[0.031]	[0.033]	[0.032]
	(18,123)	(18,117)	(18,123)	(8081)	(8480)	(10,684)	(3856)	(17,632)
Log [Nr. T-100 seats]	0.236***	0.391***	0.220***	0.227***	0.241***	0.224***	0.213***	0.243***
	[0.033]	[0.068]	[0.067]	[0.030]	[0.043]	[0.034]	[0.029]	[0.033]
	(18,080)	(18,074)	(18,080)	(8058)	(8454)	(10,656)	(3850)	(17,593)

Source: OAG, DOT DB1B Data, DOT T-100 Data.
Notes: Robust standard errors, clustered by route, are in brackets.
Number of observations in the regression in parentheses.
Unless noted otherwise, regressions weighted by total passengers on route for all periods.
Unless noted otherwise, nonstop overlaps defined as routes where both merging parties had at least 5 roundtrips in the week of July 9–15 of the merger year.
***/**/* denote significance of coefficients at 1%/5%/10% level of significance.

Table 9a
Sensitivity results for connecting overlaps.

Dependent variable	Base	2→1	3→2	4→3, 3→2, 2→1	5-5-30	10 PPDEW	+/−1 Year	+/−2 Year, Exc. post year	+/−3 Year, Exc.post year
Log [Avg. fare]	0.002	−0.042**	0.010	0.007	−0.046***	0.005	0.017	−0.001	−0.017
	[0.011]	[0.017]	[0.012]	[0.009]	[0.015]	[0.009]	[0.011]	[0.014]	[0.014]
	(50,514)	(17,746)	(32,768)	(68,658)	(34,832)	(103,825)	(29,530)	(37,887)	(58,638)
Log [90th percentile fare]	−0.004	−0.033	0.004	0.003	−0.055***	−0.005	0.015	−0.006	−0.024*
	[0.013]	[0.025]	[0.014]	[0.009]	[0.016]	[0.010]	[0.011]	[0.014]	[0.014]
	(50,514)	(17,746)	(32,768)	(68,658)	(34,832)	(103,825)	(29,530)	(37,887)	(58,638)
Log [Nr. passengers]	0.012	0.046**	0.006	−0.001	0.067***	0.004	0.013	0.011	0.025
	[0.014]	[0.021]	[0.017]	[0.012]	[0.020]	[0.012]	[0.016]	[0.019]	[0.019]
	(50,514)	(17,746)	(32,768)	(68,658)	(34,832)	(103,825)	(29,530)	(37,887)	(58,638)

Source: OAG, DOT DB1B Data.
Notes: Robust standard errors, clustered by route, are in brackets.
Number of observations in the regression in parentheses.
Unless noted otherwise, regressions weighted by total passengers on route for all periods.
Unless noted otherwise, connecting overlaps defined as routes where both merging parties had at least 10% share of passengers and combined they had at least 40% share in the pre-merger period.
***/**/* denote significance of coefficients at 1%/5%/10% level of significance.

Table 9b
Sensitivity results for connecting overlaps.

Dependent variable	Base	HHI dummy	Non-weighted	LCC filter	Pax filter	Distance filter	OD filter	Demo
Log [Avg. fare]	0.002	−0.039	0.016	0.006	0.000	0.006	0.008	0.004
	[0.011]	[0.033]	[0.011]	[0.011]	[0.011]	[0.011]	[0.011]	[0.011]
	(50,514)	(50,514)	(50,514)	(39,824)	(45,890)	(48,291)	(23,776)	(49,476)
Log [90th percentile fare]	−0.004	−0.093**	0.004	0.006	−0.009	0.000	0.007	−0.001
	[0.013]	[0.037]	[0.011]	[0.013]	[0.013]	[0.013]	[0.013]	[0.012]
	(50,514)	(50,514)	(50,514)	(39,824)	(45,890)	(48,291)	(23,776)	(49,476)
Log [Nr. passengers]	0.012	0.100**	−0.012	0.008	0.014	0.007	0.007	0.012
	[0.014]	[0.042]	[0.017]	[0.014]	[0.015]	[0.014]	[0.015]	[0.015]
	(50,514)	(50,514)	(50,514)	(39,824)	(45,890)	(48,291)	(23,776)	(49,476)

Source: OAG, DOT DB1B Data.
Notes: Robust standard errors, clustered by route, are in brackets.
Number of observations in the regression in parentheses.
Unless noted otherwise, regressions weighted by total passengers on route for all periods.
Unless noted otherwise, connecting overlaps defined as routes where both merging parties had at least 10% share of passengers and combined they had at least 40% share in the pre-merger period.
***/**/* denote significance of coefficients at 1%/5%/10% level of significance.

Table 10
Placebo test.

	Nonstop		Connecting	
Dependent variable	Base	Placebo test	Base	Placebo test
Log [Avg. fare]	−0.063**	0.052***	0.002	0.005
	[0.026]	[0.017]	[0.011]	[0.011]
	(18,123)	(18,127)	(50,514)	(50,438)
Log [90th percentile Fare]	−0.030	0.112***	−0.004	-0.002
	[0.020]	[0.031]	[0.013]	[0.015]
	(18,123)	(18,127)	(50,514)	(50,438)
Log [Nr. passengers]	0.120***	−0.024	0.012	−0.013
	[0.032]	[0.022]	[0.014]	[0.018]
	(18,123)	(18,127)	(50,514)	(50,438)
Log [Nr. T-100 seats]	0.236***	0.001		
	[0.033]	[0.027]		
	(18,080)	(17,970)		

Source: OAG, DOT DB1B Data, DOT T-100 Data.
Notes: Robust standard errors, clustered by route, are in brackets.
Number of observations in the regression in parentheses.
Models weighted by total passengers on route for all periods.
***/**/* denote significance of coefficients at 1%/5%/10% level of significance.

In the last three columns, we alter the time periods used to evaluate the regression. First, we use a time period of one year pre- and post-merger rather than two years pre- and post-merger. In the following two columns, we consider, respectively, two and three years before and after the merger but exclude the first year after the merger from the post-merger time period, to allow time for the effects of the merger to come to fruition.

In the second column in Table 9b, we replace the dummy variable in the regression with a measure of change in concentration due to the merger, in this case change in HHI, which we divide by 5000 (the maximum possible change due to a merger) to arrive to a measure taking values between 0 and 1. In the following column, we show the results of unweighted OLS regressions.

Finally, in the last four columns, we add additional filters on the set of control routes, which are defined in the same way as in the sensitivities for our nonstop regressions.

This broad set of alternative specifications strongly supports our conclusion of no competitive harm on connecting overlaps. There is not a single specification that shows a statistically significant increase in nominal fares or a statistically significant reduction in output.

Lastly, in Table 10, we present the results of a "placebo" test, in which separately for each merger, we shift the time period back three years or more so that the new, modified pre- and post-merger time periods are entirely within the actual merger's *pre-merger* time period. Thus, in the placebo test we counterfactually act as if each merger occurred three years before it actually happened. We then evaluate the "merger" effects on the routes affected by actual merger, and otherwise keep everything else (including the regression specification as well as the sets of treatment and control routes) the same. In this way,

we test whether our results are potentially driven by our model specification, in which case the results of the placebo test would be similar to our base results. Instead, the results of the placebo test are starkly different from our base regression results: *Unlike our base results, we find no instances of negative fare effects and positive output effects in the placebo cases.*

6. Conclusion

The effect of the recent legacy mergers in the airline industry have generated much debate, with many claiming they have led to anti-competitive effects including fare increases and output reductions. If there were such anticompetitive effects from these mergers, one would expect them to occur most strongly on routes in which the merging parties overlapped, and few other carriers were present, pre-merger. We find no such effects on overlap routes and thus no support for the claims of anti-competitive effects.

One implication of our findings is that any fare increases that have been observed since the mergers were very unlikely to have been caused by the mergers. In particular, our results demonstrate pro-competitive output expansions on nonstop overlap routes indicating reductions in quality-adjusted fares and a lack of significant anti-competitive effects on connecting overlaps. Hence, our results demonstrate consumer welfare gains on overlap routes, without even taking credit for the large benefits on non-overlap routes (due to new online service, improved service networks at airports, fleet reallocation, etc.). While some of our results indicate that passengers on non-overlap routes also benefitted from the mergers, we leave the complete exploration of such network effects for future research.

Appendix: DB1B data processing

The Bureau of Transportation Statistics compiles the Airline Origin and Destination Survey (DB1B) data used in our analysis. DB1B data represents a 10% sample of airline tickets from reporting carriers, and includes origin, destination, and other itinerary details of passengers transported. DB1B data was processed in order to facilitate its use in our analyses. Raw DB1B data is retrieved from the Bureau of Transportation Statistics website in three separate subsets: Market, Ticket, and Coupon data.[42] The goal of processing serves two purposes: to merge the three datasets together, and to adjust existing variables or calculate additional variables.

Starting with the coupon data, we construct itineraries, calculate the total itinerary distance, and count the number of segments within each direction for each itinerary. We also use the number of directional markets as well as the round-trip flag variable from the data to classify itineraries into one-way trips, round-trips, and open jaws.

[42] http://www.transtats.bts.gov. The Coupon data contain the most disaggregated data, provided at segment level, the Market data are itinerary-level data, representing directional-market information, and the Ticket data represents summary ticket-level data.

Table A1
Detailed regression output for pooled nonstop overlap results.

Variable	Log (Avg. fare)		Log (90th percentile Fare)		Log (Nr. passengers)		Log (Nr. T-100 seats)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Merger effect nonstop overlaps	−0.063** [0.026]	-0.048 [0.032]	-0.030 [0.020]	−0.015 [0.020]	0.120*** [0.032]	0.092** [0.040]	0.236*** [0.033]	0.185*** [0.035]
Percent of nonstop passengers on route	−0.560*** [0.045]		−0.577*** [0.052]		1.054*** [0.080]		1.931*** [0.166]	
R-squared	0.936	0.929	0.937	0.932	0.965	0.961	0.964	0.951
Number of observations	18,123	18,123	18,123	18,123	18,123	18,123	18,080	18,080

Source: OAG, DOT DB1B Data, DOT T-100 Data.
Notes: Robust standard errors, clustered by route, are in brackets.
Models weighted by total passengers on route for all periods.
Regression (2) omits "Percent of Nonstop Passengers on Route", but is otherwise identical to regression (1).
Nonstop overlaps defined as routes where both merging parties had at least 5 roundtrips in the week of July 9–15 of the merger year.
***/**/* denote significance of coefficients at 1%/5%/10% level of significance.

Table A2
Detailed regression output for pooled connecting overlap results.

Variable	Log (Avg. fare)		Log (90th percentile Fare)		Log (Nr. passengers)	
	(1)	(2)	(3)	(4)	(5)	(6)
Merger effect connecting overlaps	0.002 [0.011]	−0.003 [0.013]	−0.004 [0.013]	−0.008 [0.014]	0.012 [0.014]	0.030 [0.022]
Percent of nonstop passengers on route	−0.304*** [0.019]		−0.259*** [0.021]		1.171*** [0.041]	
R-squared	0.909	0.898	0.897	0.891	0.970	0.958
Number of observations	50,514	50,514	50,514	50,514	50,514	50,514

Source: OAG, DOT DB1B Data.
Notes: Robust standard errors, clustered by route, are in brackets.
Models weighted by total passengers on route for all periods.
Regression (2) omits "Percent of Nonstop Passengers on Route", but is otherwise identical to regression (1).
Connecting overlaps defined as routes where both merging parties had at least 10% share of passengers and combined they had at least 40% share in the pre-merger period.
***/**/* denote significance of coefficients at 1%/5%/10% level of significance.

We also make a few adjustments to existing variables to better reflect the true nature of the underlying data. Based on the number of coupons, and the origins and destinations of the different legs in the coupon data, we identify true origin and destination for each directional trip. We multiply the number of passengers by 10 to reflect the DB1B survey sampling. The directional fare is set to half the itinerary fare if part of a round-trip.

To preserve only relevant, high-quality data, we implement several restrictions. To start, we restrict the data to only US carriers. We use T-100 US Domestic Segment data (also from the Bureau of Transportation Statistics) and OAG data to generate a list of US carrier codes by quarter. Any flights with either a foreign ticketing or foreign operating carrier are removed from the data. We also drop itineraries where the number

Table A3
Sensitivity results for nonstop overlaps—Delta/Northwest.

Dependent Variable	Base	2→1	3→2	4→3, 3→2, 2→1	3 Round-Trips	7 Round-Trips	+/- 1 Year	+/- 2 Year, Exc. Post	+/- 3 Year, Exc. Post	Placebo Test	HHI Dummy	Non-Weighted	LCC Filter	Pax Filter	Distance Filter	OD Filter	Demo
Log [Avg. Fare]	-0.044**	-0.117***	-0.021	-0.059**	-0.043**	-0.044**	-0.028	-0.046	-0.020	0.036*	-0.145**	-0.049**	-0.042*	-0.022	-0.044**	0.014	-0.040*
	[0.021]	[0.043]	[0.018]	[0.023]	[0.021]	[0.021]	[0.023]	[0.030]	[0.028]	[0.020]	[0.063]	[0.024]	[0.023]	[0.023]	[0.022]	[0.025]	[0.021]
	(8,554)	(6,194)	(2,360)	(9,434)	(8,761)	(8,394)	(4,262)	(6,413)	(10,690)	(8,560)	(8,549)	(8,554)	(3,682)	(3,136)	(6,924)	(1,200)	(8,300)
Log [90th Percentile Fare]	-0.023	-0.164	0.023	-0.087*	-0.022	-0.023	-0.036	-0.014	-0.012	0.120***	-0.162	-0.061	-0.015	0.004	-0.029	0.044	-0.014
	[0.041]	[0.104]	[0.029]	[0.047]	[0.041]	[0.041]	[0.054]	[0.040]	[0.051]	[0.028]	[0.119]	[0.053]	[0.042]	[0.043]	[0.041]	[0.046]	[0.040]
	(8,554)	(6,194)	(2,360)	(9,434)	(8,761)	(8,394)	(4,262)	(6,413)	(10,690)	(8,560)	(8,549)	(8,554)	(3,682)	(3,136)	(6,924)	(1,200)	(8,300)
Log [Nr. Passengers]	0.066**	0.213***	0.008	0.097	0.064**	0.066**	0.027	0.081**	0.081*	-0.068	0.202***	0.090	0.067**	0.041	0.066**	0.052	0.078**
	[0.031]	[0.057]	[0.026]	[0.061]	[0.031]	[0.031]	[0.024]	[0.034]	[0.043]	[0.054]	[0.072]	[0.061]	[0.032]	[0.033]	[0.031]	[0.034]	[0.030]
	(8,554)	(6,194)	(2,360)	(9,434)	(8,761)	(8,394)	(4,262)	(6,413)	(10,690)	(8,560)	(8,549)	(8,554)	(3,682)	(3,136)	(6,924)	(1,200)	(8,300)
Log [Nr. T-100 Seats]	0.255***	0.264	0.215***	0.162**	0.254***	0.256***	0.190***	0.305***	0.322***	-0.092*	0.492***	0.206	0.261***	0.252***	0.255***	0.198**	0.261***
	[0.070]	[0.234]	[0.057]	[0.068]	[0.070]	[0.070]	[0.058]	[0.076]	[0.083]	[0.054]	[0.143]	[0.139]	[0.073]	[0.079]	[0.070]	[0.076]	[0.071]
	(8,528)	(6,168)	(2,360)	(9,405)	(8,727)	(8,368)	(4,250)	(6,396)	(10,632)	(8,456)	(8,523)	(8,528)	(3,670)	(3,110)	(6,901)	(1,200)	(8,274)

Source: OAG, DOT DB1B Data, DOT T-100 Data.

Notes: Robust standard errors, clustered by route, are in brackets.
Number of observations in the regression in parentheses.
Unless noted otherwise, regressions weighted by total passengers on route for all periods.
Unless noted otherwise, nonstop overlaps defined as routes where both merging parties had at least 5 roundtrips in the week of July 9-15 of the merger year.
***/**/* denote significance of coefficients at 1%/5%/10% level of significance.

Table A4
Sensitivity results for nonstop overlaps - United/Continental.

Dependent Variable	Base	2→1	3→2	4→3, 3→2, 2→1	3 Round-Trips	7 Round-Trips	+/- 1 Year	+/- 2 Year, Exc. Post	+/- 3 Year, Exc. Post	Placebo Test	HHI Dummy	Non-Weighted	LCC Filter	Pax Filter	Distance Filter	OD Filter	Demo
Log [Avg. Fare]	-0.013 [0.013] (2,267)		-0.013 [0.013] (2,267)	0.048 [0.030] (3,182)	-0.017 [0.013] (2,315)	0.009 [0.026] (2,219)	0.018 [0.017] (1,134)	-0.032** [0.014] (1,701)	-0.038** [0.018] (2,833)	0.085*** [0.025] (2,265)	-0.214 [0.181] (2,267)	0.016 [0.013] (2,267)	-0.006 [0.015] (1,376)	-0.007 [0.014] (1,632)	0.016 [0.015] (784)	-0.003 [0.016] (1,040)	0.002 [0.014] (2,192)
Log [90th Percentile Fare]	-0.020 [0.021] (2,267)		-0.020 [0.021] (2,267)	0.066 [0.040] (3,182)	-0.023 [0.021] (2,315)	0.050 [0.086] (2,219)	0.046** [0.018] (1,134)	-0.067 [0.041] (1,701)	-0.092** [0.041] (2,833)	0.201*** [0.043] (2,265)	-0.216 [0.212] (2,267)	0.018 [0.021] (2,267)	-0.017 [0.023] (1,376)	-0.017 [0.023] (1,632)	0.009 [0.023] (784)	-0.015 [0.024] (1,040)	-0.014 [0.021] (2,192)
Log [Nr. Passengers]	0.072* [0.040] (2,267)		0.072* [0.040] (2,267)	0.046 [0.029] (3,182)	0.075* [0.040] (2,315)	-0.002 [0.033] (2,219)	0.052* [0.031] (1,134)	0.070 [0.048] (1,701)	0.156*** [0.047] (2,833)	0.016 [0.019] (2,265)	0.730** [0.335] (2,267)	0.059 [0.042] (2,267)	0.077* [0.042] (1,376)	0.067 [0.041] (1,632)	0.019 [0.044] (784)	0.065 [0.041] (1,040)	0.050 [0.039] (2,192)
Log [Nr. T-100 Seats]	0.264*** [0.027] (2,262)		0.264*** [0.027] (2,262)	0.163*** [0.042] (3,172)	0.266*** [0.027] (2,310)	0.182*** [0.061] (2,214)	0.180*** [0.018] (1,131)	0.289*** [0.045] (1,697)	0.317*** [0.043] (2,829)	0.027 [0.034] (2,263)	1.656*** [0.333] (2,262)	0.270*** [0.043] (2,262)	0.266*** [0.034] (1,371)	0.243*** [0.023] (1,632)	0.229*** [0.042] (779)	0.300*** [0.036] (1,035)	0.266*** [0.028] (2,187)

Source: OAG, DOT DB1B Data, DOT T-100 Data.

Notes: Robust standard errors, clustered by route, are in brackets.

Number of observations in the regression in parentheses.

Unless noted otherwise, regressions weighted by total passengers on route for all periods.

Unless noted otherwise, nonstop overlaps defined as routes where both merging parties had at least 5 roundtrips in the week of July 9-15 of the merger year.

***/**/* denote significance of coefficients at 1%/5%/10% level of significance.

Table A5
Sensitivity results for nonstop overlaps - American/US Airways.

Dependent Variable	Base	2→1	3→2	4→3, 3→2, 2→1	3 Round-Trips	7 Round-Trips	+/- 1 Year	+/- 2 Year, Exc. Post	+/- 3 Year, Exc. Post	Placebo Test	HHI Dummy	Non-Weighted	LCC Filter	Pax Filter	Distance Filter	OD Filter	Demo
Log [Avg. Fare]	-0.123*** [0.042] (7,302)	-0.112* [0.064] (5,070)	-0.178*** [0.026] (2,232)	-0.101*** [0.022] (8,150)	-0.121*** [0.042] (7,710)	-0.101** [0.041] (6,370)	-0.109** [0.044] (3,643)	-0.113** [0.047] (5,478)	-0.103** [0.048] (7,304)	0.045* [0.024] (7,302)	-0.307*** [0.052] (7,301)	-0.088* [0.051] (7,302)	-0.100** [0.043] (3,023)	-0.132*** [0.043] (3,712)	-0.102** [0.042] (2,976)	-0.113** [0.045] (1,616)	-0.121*** [0.043] (7,140)
Log [90th Percentile Fare]	-0.057 [0.042] (7,302)	-0.032 [0.055] (5,070)	-0.122*** [0.014] (2,232)	-0.089** [0.035] (8,150)	-0.054 [0.040] (7,710)	-0.051 [0.034] (6,370)	-0.064*** [0.020] (3,643)	-0.028 [0.060] (5,478)	-0.037 [0.063] (7,304)	0.042* [0.024] (7,302)	-0.218*** [0.069] (7,301)	-0.030 [0.038] (7,302)	-0.035 [0.041] (3,023)	-0.070 [0.049] (3,712)	-0.039 [0.039] (2,976)	-0.044 [0.045] (1,616)	-0.052 [0.044] (7,140)
Log [Nr. Passengers]	0.202*** [0.061] (7,302)	0.183* [0.095] (5,070)	0.249*** [0.030] (2,232)	0.143*** [0.039] (8,150)	0.202*** [0.060] (7,710)	0.162*** [0.051] (6,370)	0.190*** [0.062] (3,643)	0.192** [0.083] (5,478)	0.199*** [0.074] (7,304)	-0.043* [0.025] (7,302)	0.386*** [0.062] (7,301)	0.235** [0.102] (7,302)	0.191*** [0.060] (3,023)	0.199*** [0.060] (3,712)	0.165*** [0.056] (2,976)	0.191*** [0.054] (1,616)	0.199*** [0.058] (7,140)
Log [Nr. T-100 Seats]	0.196*** [0.057] (7,290)	0.143* [0.077] (5,062)	0.260*** [0.013] (2,228)	0.120*** [0.029] (8,138)	0.200*** [0.064] (7,687)	0.150*** [0.043] (6,361)	0.169*** [0.049] (3,638)	0.178** [0.083] (5,468)	0.188** [0.082] (6,381)	0.033 [0.036] (7,251)	0.277*** [0.080] (7,289)	0.214*** [0.045] (7,290)	0.197*** [0.050] (3,017)	0.185*** [0.053] (3,712)	0.184*** [0.053] (2,976)	0.193*** [0.043] (1,615)	0.195*** [0.056] (7,132)

Source: OAG, DOT DB1B Data, DOT T-100 Data.

Notes: Robust standard errors, clustered by route, are in brackets.

Number of observations in the regression in parentheses.

Unless noted otherwise, regressions weighted by total passengers on route for all periods.

Unless noted otherwise, nonstop overlaps defined as routes where both merging parties had at least 5 roundtrips in the week of July 9-15 of the merger year.

***/**/* denote significance of coefficients at 1%/5%/10% level of significance.

Table A6
Sensitivity results for connecting overlaps - Delta/Northwest.

Dependent Variable	Base	2→1	3→2	4→3, 3→2, 2→1	5-5-30	10 PPDEW	+/- 1 Year	+/- 2 Year, Exc. Post Year	+/- 3 Year, Exc. Post Year	Placebo Test	HHI Dummy	Non-Weighted	LCC Filter	Pax Filter	Distance Filter	OD Filter	Demo
Log [Avg. Fare]	-0.037* [0.020] (19,230)	-0.096*** [0.032] (8,718)	-0.027 [0.023] (10,512)	-0.011 [0.014] (25,134)	-0.094*** [0.030] (13,084)	-0.020 [0.014] (34,405)	0.000 [0.018] (9,783)	-0.066** [0.029] (14,423)	-0.068*** [0.025] (24,280)	0.044** [0.018] (19,226)	-0.297*** [0.069] (19,230)	-0.005 [0.018] (19,230)	-0.028 [0.021] (14,832)	-0.027 [0.020] (16,206)	-0.030 [0.020] (18,622)	-0.021 [0.021] (9,984)	-0.037* [0.020] (18,848)
Log [90th Percentile Fare]	-0.046** [0.019] (19,230)	-0.119*** [0.036] (8,718)	-0.028 [0.021] (10,512)	-0.025* [0.014] (25,134)	-0.147*** [0.036] (13,084)	-0.038*** [0.014] (34,405)	-0.010 [0.017] (9,783)	-0.079*** [0.026] (14,423)	-0.090*** [0.023] (24,280)	0.083*** [0.023] (19,226)	-0.431*** [0.078] (19,230)	-0.032* [0.016] (19,230)	-0.030 [0.020] (14,832)	-0.047** [0.018] (16,206)	-0.038** [0.018] (18,622)	-0.019 [0.020] (9,984)	-0.042** [0.019] (18,848)
Log [Nr. Passengers]	0.010 [0.025] (19,230)	0.025 [0.035] (8,718)	0.015 [0.030] (10,512)	-0.009 [0.019] (25,134)	0.078* [0.040] (13,084)	-0.017 [0.018] (34,405)	0.017 [0.026] (9,783)	0.006 [0.036] (14,423)	0.030 [0.034] (24,280)	-0.090*** [0.034] (19,226)	0.203*** [0.078] (19,230)	-0.022 [0.029] (19,230)	0.008 [0.026] (14,832)	-0.015 [0.025] (16,206)	0.004 [0.025] (18,622)	0.004 [0.027] (9,984)	0.005 [0.025] (18,848)

Source: OAG, DOT DB1B Data.
Notes: Robust standard errors, clustered by route, are in brackets.
Number of observations in the regression in parentheses.
Unless noted otherwise, regressions weighted by total passengers on route for all periods.
Unless noted otherwise, connecting overlaps defined as routes where both merging parties had at least 10 percent share of passengers and combined they had at least 40 percent share in the pre-merger period.
***/**/* denote significance of coefficients at 1%/5%/10% level of significance.

Table A7
Sensitivity results for connecting overlaps - United/Continental.

Dependent Variable	Base	2→1	3→2	4→3, 3→2, 2→1	5-5-30	10 PPDEW	+/- 1 Year	+/- 2 Year, Exc. Post Year	+/- 3 Year, Exc. Post Year	Placebo Test	HHI Dummy	Non-Weighted	LCC Filter	Pax Filter	Distance Filter	OD Filter	Demo
Log [Avg. Fare]	0.036 [0.027] (10,432)		0.036 [0.027] (10,432)	0.055*** [0.015] (16,048)	0.159*** [0.042] (7,696)	0.043** [0.021] (33,528)	0.076*** [0.024] (9,528)	0.036 [0.032] (7,824)	0.008 [0.029] (12,980)	0.017 [0.030] (10,432)	0.234** [0.112] (10,432)	0.042* [0.025] (10,432)	0.045* [0.027] (9,872)	0.032 [0.027] (9,632)	0.036 [0.027] (9,872)	0.038 [0.030] (3,488)	0.034 [0.027] (10,320)
Log [90th Percentile Fare]	0.003 [0.046] (10,432)		0.003 [0.046] (10,432)	0.036 [0.023] (16,048)	0.138*** [0.033] (7,696)	0.005 [0.037] (33,528)	0.067* [0.037] (9,528)	0.001 [0.053] (7,824)	-0.021 [0.035] (12,980)	0.022 [0.049] (10,432)	0.017 [0.130] (10,432)	0.030 [0.030] (10,432)	0.012 [0.046] (9,872)	0.007 [0.046] (9,632)	0.003 [0.046] (9,872)	0.007 [0.048] (3,488)	0.000 [0.046] (10,320)
Log [Nr. Passengers]	0.012 [0.048] (10,432)		0.012 [0.048] (10,432)	-0.039 [0.026] (16,048)	-0.278* [0.156] (7,696)	0.027 [0.040] (33,528)	0.051 [0.056] (9,528)	0.014 [0.063] (7,824)	0.029 [0.075] (23,620)	-0.022 [0.044] (10,432)	-0.018 [0.182] (10,432)	-0.009 [0.044] (10,432)	-0.001 [0.047] (9,872)	0.016 [0.047] (9,632)	0.012 [0.048] (9,872)	0.005 [0.049] (3,488)	0.017 [0.046] (10,320)

Source: OAG, DOT DB1B Data.
Notes: Robust standard errors, clustered by route, are in brackets.
Number of observations in the regression in parentheses.
Unless noted otherwise, regressions weighted by total passengers on route for all periods.
Unless noted otherwise, connecting overlaps defined as routes where both merging parties had at least 10 percent share of passengers and combined they had at least 40 percent share in the pre-merger period.
***/**/* denote significance of coefficients at 1%/5%/10% level of significance.

Table A8
Sensitivity results for connecting overlaps - American/US Airways.

Dependent Variable	Base	2→1	3→2	4→3, 3→2, 2→1	5-5-30	10 PPDEW	+/- 1 Year	+/- 2 Year, Exc. Post Year	+/- 3 Year, Exc. Post Year	Placebo Test	HHI Dummy	Non-Weighted	LCC Filter	Pax Filter	Distance Filter	OD Filter	Demo
Log [Avg. Fare]	0.010	-0.025	0.020	-0.003	-0.037**	0.015	0.013	0.018	0.017	-0.018	0.047	0.024*	0.014	0.003	0.015	0.012	0.016
	[0.014]	[0.017]	[0.017]	[0.015]	[0.016]	[0.012]	[0.015]	[0.017]	[0.017]	[0.015]	[0.040]	[0.014]	[0.015]	[0.014]	[0.014]	[0.015]	[0.014]
	(20,852)	(9,028)	(11,824)	(27,476)	(14,052)	(35,892)	(10,219)	(15,640)	(21,378)	(20,780)	(20,852)	(20,852)	(15,120)	(20,052)	(19,797)	(10,304)	20,308
Log [90th Percentile Fare]	0.012	0.000	0.018	0.005	-0.029*	0.017	0.014	0.025	0.026	-0.051***	0.063	0.027*	0.021	0.004	0.016	0.016	0.020
	[0.016]	[0.022]	[0.020]	[0.012]	[0.016]	[0.014]	[0.014]	[0.017]	[0.016]	[0.018]	[0.041]	[0.016]	[0.018]	[0.017]	[0.016]	[0.017]	[0.016]
	(20,852)	(9,028)	(11,824)	(27,476)	(14,052)	(35,892)	(10,219)	(15,640)	(21,378)	(20,780)	(20,852)	(20,852)	(15,120)	(20,052)	(19,797)	(10,304)	20,308
Log [Nr. Passengers]	0.017	0.075***	0.004	0.019	0.081***	0.018	0.007	0.018	0.028	0.030	0.077	0.001	0.011	0.028	0.011	0.012	0.021
	[0.020]	[0.024]	[0.022]	[0.018]	[0.021]	[0.017]	[0.021]	[0.026]	[0.023]	[0.023]	[0.056]	[0.024]	[0.019]	[0.019]	[0.019]	[0.020]	[0.020]
	(20,852)	(9,028)	(11,824)	(27,476)	(14,052)	(35,892)	(10,219)	(15,640)	(21,378)	(20,780)	(20,852)	(20,852)	(15,120)	(20,052)	(19,797)	(10,304)	20,308

Source: OAG, DOT DB1B Data.
Notes: Robust standard errors, clustered by route, are in brackets.
Number of observations in the regression in parentheses.
Unless noted otherwise, regressions weighted by total passengers on route for all periods.
Unless noted otherwise, connecting overlaps defined as routes where both merging parties had at least 10 percent share of passengers and combined they had at least 40 percent share in the pre-merger period.
***/**/* denote significance of coefficients at 1%/5%/10% level of significance.

of coupons in a direction is greater than three, itineraries where the origin and destination are identical for any direction, itineraries identified as bulk fares, itineraries where the directional fare is less than $25, and itineraries where the fare is identified as not-credible.

Appendix Tables 3–8.

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